Remarks

Entry of the amendments presented, and withdrawal of the claim objections and rejections are respectfully requested. Claims 1-11, 13-24 & 26 remain pending. The objections and rejections stated in the initial Office Action are addressed separately below in the order raised in the Office Action.

Claim Objections:

By this paper, objected to claims 12, 25 & 27 are canceled without prejudice. The subject matter of these claims is believed well covered by the remaining claims of record. In view of these amendments, the claim objections are believed moot.

35 U.S.C. §101:

Original claims 14-16 & 22-26 were rejected under 35 U.S.C. §101 as being directed to non-statutory subject matter, and in particular, as reciting only software logic and means. By this paper, and without acquiescing to the appropriateness of the 35 U.S.C. §101 rejection, applicants amend independent claims 14 & 22 to recite an independent, hardware interlock device coupled to the outputs of the redundant controllers to ensure that output controlled by only the controller with active control is enabled as input to the at least one device, wherein the independent, hardware interlock device is separate from and external to the redundant controllers. By reciting this hardware interlock device, applicants submit that the claims at issue (that is, claims 14-16 & 22-26) now recite statutory subject matter under 35 U.S.C. §101. Withdrawal of the rejection thereof is therefore respectfully requested to any extent deemed applicable.

35 U.S.C. §102(e):

In the Office Action, original claims 1-27 were rejected under 35 U.S.C. §102(e) as being anticipated by Krishnamurthy et al. (U.S. Patent Publication No. 2004/0073833 A1; herein after Krishnamurthy). This rejection is respectfully traversed to any extent deemed applicable to the claims presented herewith.

By this paper, independent claims 1, 9, 14 & 22 are amended to more particularly point out and distinctly claim certain aspects of the present invention. These amendments are submitted without acquiescing to the originally stated rejection, and are provided in a *bona fide* attempt to further prosecution of the application. In particular, each pending independent claim is amended to recite an independent, hardware interlock device coupled to the outputs of the redundant controllers. This independent, hardware interlock device is separate from and external to the redundant controllers. Support for the amended language can be found throughout the application as filed, for example, reference FIG. 3B and the supporting discussion thereof. No new matter is added to the application by any amendment presented.

Applicants recite (e.g., in amended claim 1) a method of providing arbitration for redundant controllers, which includes:

- providing logic for automatically determining which controller of redundant controllers is active controller, wherein outputs controlled by the redundant controllers are electrically connected together and provided as input to at least one device,
- providing *an independent, hardware interlock device coupled to the outputs of the redundant controllers,*
- *the independent, hardware interlock device ensuring that output controlled by only the active controller is enabled as input to the at least one device, and*
- *the independent, hardware interlock device being separate from and external to the redundant controllers.*

Applicants respectfully submit that at least the above-italicized aspects of their invention patentably distinguish their invention from the teachings and suggestions of Krishnamurthy, as well as the other art of record.

Krishnamurthy discloses apparatus and methods for redundant management of computer systems. An interconnect system connects two drawer management cards (DMCs) of a drawer. The drawer contains a plurality of independent nodes, which are managed by at least two DMCs. Thus, if one of the DMCs fails, the other DMC can take over and manage the drawer. In one embodiment of Krishnamurthy, the nodes within a drawer are managed through an intelligent platform management bus (IPMB). The first and second DMCs are interconnected with each

other within a chassis of the drawer. The two DMCs are also interconnected within the management channels (e.g., busses) of the drawer. During power up, the first DMC and the second DMC on the drawer may determined whether the DMCs are interconnect (or not). The DMCs then decide each of their roles (i.e., determining which DMC should be in an active state and which DMC should be in a standby state). Thus, by interconnecting the two DMCs, both the DMCs are able to manage nodes on a drawer and the drawer is allowed to operate uninterrupted in the event of a failure or inoperativeness of one of the DMCs. (See abstract of Krishnamurthy.)

Page 3 of the Office Action of December 26, 2006, references page 6, paragraph [0056], as well as FIG. 2 of Krishnamurthy. Since FIG. 2 refers to the form factors that are defined for the compact PCI node card, applicants believe the Office Action intended to reference FIG. 8, which is a block diagram showing an exemplary interconnect system for a redundant computer system according to one embodiment of Krishnamurthy. Paragraph [0056] of Krishnamurthy teaches:

> Initially, at least one DMC is provided in each drawer. When the two (or more) drawers (or DMCs) are connected together using DBA, only one DMC will function as master (active) DMC and another DMC will function as a standby DMC. Referring now to FIG. 10a, the drawers (or DMCs) are powered ON at the same time (1010). A DMC then runs a self test at step 1020. If it passes the self test, a DMC software (running on the DMC) asserts a health signal (e.g., a HEALTHY#_OUT) to determine the health of the DMC (1030). If the signal indicates the DMC is not healthy, the DMC enters into a failed state (e.g., the HEALTHY#_OUT signal of one DMC will go as input to another DMC as HEALTHY#_IN) (1040). If the DMC passes the health determination (i.e., it is healthy), the DMC then checks whether the other DMC is present in the system (or not) by probing a present signal (e.g., a PRESNT_IN# signal) which is coming from the other DMC (1050). If the other DMC is present, a selecting algorithm or software will be run to determine which DMC will be in a master state and which will be in a standby state (e.g., 1060, 1080). For example, when both the DMCs are present in the system, both the DMCs will check whether the other DMC is in master (active) role (or not) by checking , a master signal, such as a Master_IN# signal (1060). If none of the DMCs are in the master role, the DMCs check the slot identification (SLOT_ID) on each of the DMC (1080). The slot identifications (slot ids) are different for each drawer (or DMC), for example, if one drawer (or DMC) is zero, the other drawer (or DMC) will be one. The DMCs use this difference to decide their master/standby role. Referring also to FIG. 9, the slot ids 818a-b, respectively, may be hardwired and fixed by using a drawer bridge assembly 817a-b (having a pull-up resistor). The DMC which is suppose to be the master (e.g., having a SLOT_ID=0) will assert the Master_OUT# bit and acquire the master role (1090). The other DMC will act in a standby role until the active DMC fails or when there is a user intervention. If only one DMC is present in the system, the DMC will take an active role immediately (1090).

The above-noted paragraph from Krishnamurthy teaches a software control mechanism that is implemented within the controllers (DMCs) of Krishnamurthy that allows for switching from one controller to another, and which allows each DMC to determine whether it is in a master or standby role. The secondary DMC acts in the standby role until the active DMC fails, or when there is a user intervention.

Applicants respectfully submit that the above-noted teachings from Krishnamurthy do not teach or suggest the existence of an independent, hardware interlock device coupled to the outputs of the redundant controllers. Krishnamurthy indicates that only one controller is active at a time, but relies upon a software protocol to ensure that one controller is the master and the other is in standby. In accordance with applicants' invention, an independent, hardware interlock device is provided which is coupled to the outputs of the redundant controllers which independently ensures that output controlled by only the active controller is enabled as input to the at least one device. This difference is significant.

The problem addressed by the present invention is to enhance availability of a control function employing redundant controllers. Specifically, if one controller should fail, it is desirable that that failure not impede the ability of the second controller from performing its task. For example, if one controller has a fixed bit or open bit, it should not be able to prevent the other controller from performing the control function. Similarly, if one controller has a software problem that causes it to "hang", it should not prevent the other controller from performing the control function. Further, the invention recited herein provides a means of ensuring that the two controllers do not try to perform the control function at the same time. Such an attempt could damage the controller output signals or the device being controlled, or even cause malfunction of the device or process being controlled. Krishnamurthy does not address these particular problems.

In Krishnamurthy, a control protocol is implemented in software within the redundant controllers themselves. Such a configuration presents the problems to which the present invention is directed. For example, in Krishnamurthy, a stuck PRSNT#_A (815a) or PRSNT#_B (815b) bit could cause both controllers to think they are the only one present, thus resulting in both controllers trying to provide control resulting in potential failure. Applicants' recited

invention would not allow this to happen. Similarly, an open control signal between the controllers could result in both controllers of Krishnamurthy being inoperative. If the master controller fails with its RST_OUT# signal stuck low, both controllers would be inoperative in Krishnamurthy.

To summarize, Krishnamurthy does not address the above-noted possible malfunction problems of one of their redundant controllers. Applicants' invention does.

Additionally, applicants' independent claims recite that the independent, hardware interlock device is separate from and external to the redundant controllers. In Krishnamurthy, the control protocol is implemented in software within and between the redundant controllers. This difference is also significant.

In Krishnamurthy, the control protocol requires proper functioning of the programs of both controllers, in addition to the millions of circuits comprising their processing units and output control logic. In contrast, applicants' independent, hardware interlock device is separate and external to the redundant controllers, and thus, proper functioning thereof does not rely on proper functioning of the redundant controllers. In accordance with applicants' invention, the arbitration and redundancy switching function at the outputs is removed from the redundant controllers, one or more of which may be faulty, and ensures that a failed controller that has become inactive or non-responsive for any reason will relinquish control. This allows the backup controller to take control without any action necessary from the currently active controller. Again, this all occurs external to and separate from the redundant controllers via the independent, hardware interlock device coupled to the outputs of the redundant controllers.

For at least the above-noted reasons, applicants respectfully submit that the independent claims presented patentably distinguish over the applied art. The dependent claims are believed allowable for the same reasons as the independent claims, as well as for their own additional characterizations. For example, dependent claims 6-8 & 19-22 recite that the independent, hardware interlock device includes a hardware state machine to enable/disable outputs controlled by each controller of the redundant controllers and to ensure that output of only the active controller is enabled as input to the at least one device. No such hardware state machine is taught or suggested by the software control protocol of Krishnamurthy.

All claims are believed to be in condition for allowance, and such action is respectfully requested.

If a telephone conference would be of assistance in advancing prosecution of the subject application, applicants' undersigned attorney invites the telephone him at the number provided.

Respectfully submitted,

Kevin P. Radigan

Kevin P. Radigan
Attorney for Applicants
Registration No.: 31,789

Dated: February 28, 2007

HESLIN ROTHENBERG FARLEY & MESITI P.C.
5 Columbia Circle
Albany, New York 12203-5160
Telephone: (518) 452-5600
Facsimile: (518) 452-5579